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Preface

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This special issue of the Journal of Natural Computing (NaCo) is based on ACRI 2016, the 12th international conference on Cellular Automata for Research and Industry, held in Fez, Morocco, September 5–8, 2016. ACRI 2016 was organized by the University of Perpignan, IMAGES_Espace-Dev, the UMR 228 IRD UM UG UR "Espace pour le Développement", and the AGH University of Science and Technology of Kraków, Poland, in association with the International Systems Theory Network located in Fès (Morocco). Its primary goal was to bring together researchers from a large variety of scientific fields in order to promote international collaborations on cellular automata research as well as to exchange knowledge between experts in several diverse scientific areas: pure and applied mathematics, computer science, physics, biology, and mathematical systems theory.

Cellular Automata (CA) represent a very powerful approach to the study of spatio-temporal systems where complex phenomena emerge from many simple local interactions. They are discrete, abstract computational systems that have proved useful both as general models of complexity and as simplified representations of non-linear dynamics in a wide range of scientific areas. In the last few decades, cellular automata have generated a great deal of interest both in academia and industry as they are attracting an increasing community of researchers working in different fields and dealing with theoretical aspects as well as practical applications.

From a collection of 45 articles presented at the conference and included in a LNCS volume together with four invited contributions, 13 papers were selected by the Steering Committee of the ACRI Conference Series. Their authors were invited to submit extended and improved versions to be published in this special issue. Each paper was carefully reviewed by two or three expert referees and finally 11 papers have been accepted for publication. The papers cover theoretical and algorithmic aspects of cellular automata, as well as applications to modeling of different kinds of complex systems and phenomena.

The contributions are listed below, following an order from more theoretical to more applied.

The first two papers, [Umeo et al.] and [Dimitriadis et al.] propose synchronization algorithms for special cases of a classic problem in the theory of Cellular Automata, the Firing Squad Synchronization Problem (FSSP). The paper by Umeo et al. studies FSSP from a viewpoint of state-change complexity that models the energy consumption while the proposed algorithm by Dimitriadis et al. deals with dynamic fault tolerant FSSP.

Another classic problem, the Density Classification Problem, is considered in [Dembowski et al.] in the context of Affine Continuous Cellular Automata, and necessary conditions for solving the problem in the case of a fixed number of cells are formulated.

[Bagnoli et al.] address the question of regional reachability and drivability for 1D Boolean cellular automata by

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analyzing how interior cells may be controlled from the two ends boundary cells. The paper constitutes an interesting step toward solving the general problem of regional controllability of CA via boundary actions for nonlinear or stochastic CA.

In [Mariot and Leporati] CA global rules are considered from a coding-theoretic point of view. In particular, it is shown that linear CA are equivalent to linear cyclic codes, observing that the syndrome computation process corresponds to the application of the CA global rule, while the error-correction capability of the code is related to the resiliency order of the global rule.

The paper by [Isokawa et al.] presents a computational universal Brownian cellular automaton with 3 internal states and 2 transition rules. The universality is shown by embedding a set of Priese's delay-insensitive circuit elements.

[Merzouki et al.] propose a 2D vertex model of circular cross sections of cell monolayers to investigate how cell mechanical properties and proliferation affect the shape of in silico growing tissues.

The following papers have a more applicative flavor. In [Rundo et al.], CA are proposed as the basis for a novel semi-automatic seeded image segmentation method for MRI brain cancer detection and delineation. Experimentation is carried out on a dataset composed from 32 brain cancers.

The work of [Schlotterbeck et al.] explores coordination strategies to produce a set of agents that best observe an environment through local and incomplete information. A Cellular Automaton model is proposed to study the ability to build an observer for a complex system using a decentralized multi-agent system for the coordination of mobile sensors.

Another interesting application is shown in [Lupiano et al.], which presents SCIDDICA, a competitive (related to PDE approach) Cellular Automata model for 3-dimensional simulation of flow-like landslides.

Finally, the paper of [Marcou et al.] investigates a modelling approach for the evolution of a section of the Algerian coastline. The proposed CA model for the simulation of sedimentation process during erosion of coasts, is coupled with a Lattice Boltzman method for the development of the corresponding hydrodynamic model.

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